



United States Patent Application For

EXPANSION MOTOR

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Background of the invention

In manufacturing, engineering and scientific work often it is needed to clamp, or manipulate parts, or control a gap space between them. Arrays of devices are used to manipulate parts so new features can be created with proper relationship to existing features when machining parts. In power transmission trains shafts are coupled and pulleys are clamped in place. Optical alignment sometimes requires alignment in angstroms to split light beams. Before mentioned are some of tasks that deal with clearances or clamping ranges few thousands of an inch or millimeters. This work requires this excursion of a movable feature of these devices to be controlled within this barely visible range. In some instances as with a brake or clutch the movement is practically non measurable as a preload is being applied. That is, pressure on contacting surfaces is increased or decreased as with a brakes and clutches. Another example of micro inch movement is with the displacement of the mounting of variable stiffness hydraulic dampeners.

These type clamping is disclosed in an early example using an expandable sleeve is in U.S. Pat. No. 4,366,735 U.S. and later Pat. No. 6,077,003 each using seals of various materials. Other chucks and holding devices are shown by U.S. Pat. No. 5,127,780 and U.S. Pat. No. US 6,488,285 B1. A shortcoming of the gripping sleeves is that the preload on the compressible seals is reduced as the pressure expands or reduces the removable wall. Therefore, the increasing the hydraulic pressure reduces the sealing. Melted copper seals delaminate and fail under torsion loads. Also, highly stressed fusible alloy welds also fail with the internal pressures of cooling metals. An example of a device for positioning is U.S. Pat. No. 5,362,185 showing is a widening elastic rod. A fluid under elastic membrane is shown in U.S. Pat. No. 6,375,172.

Summary and objects of the invention

The present invention overcomes the disadvantages of the prior art expandable holders by having a deformable wall that is filleted with the inside walls to improve the range of motion and also to eliminate stress concentration thereby extending the life cycle expectancy. It is a further object of the invention to hold a workpiece stiffly. Yet another objective of the invention is a means to manipulate and hold the workpiece so the axis is independent of the holder axis. Still further the invention is an actuator to move a workpiece in very small movements whereby stiction is hardly a consideration.

It is a further objective of the invention that a pressure chamber having a thin wall with rounded inside corners around the perimeters to eliminate stressed concentrations known as stress risers. The patent also provides for a device that is heat treatable after fusion or welding to normalize and relieve internal stresses.

BREIF DESCRIPTION OF THE DRAWINGS

The object and the advantages of the invention will become apparent from the following detailed description of preferred embodiments thereof in connection with the accompanying drawings in which like designate like elements in which:

FIG. 1 is a side view of a motor body according to the present invention;

FIG. 2 is an orthographic end view described in **FIG. 1**;

FIG. 3 is a section view taken along line 3---3 of the motor body described in **FIG. 1**;

FIG. 3a is an enlargement of a section of **FIG. 3** showing construction and operation according to the present invention;

FIG. 3b is also an enlargement of a section **FIG. 3** showing another construction and operation body according to the present invention;

FIG. 4 is a end view of a expansion sleeve;

FIG. 5 is a side view of **FIG. 4**;

FIG. 5a is an enlarged view described in **FIG. 5**;

FIG. 6 is a side view of yet another configuration of the motor body according to the present invention;

FIG. 7 is a orthographic projection of the side view **FIG. 6**;

FIG. 7a is an enlarged view of a break out of **FIG. 7**;

FIG. 8 is a section view taken along line 8---8 of a motor body described in **FIG. 6**;

FIG. 8b is an enlargement of section view **FIG. 8** showing operation and another construction;

FIG. 8a is another enlargement of section view **FIG. 8** showing operation and another construction;

FIG. 9 is a plan view of the cover;

FIG. 10 is an orthographic projection of the side view of **FIG. 9**;

FIG. 11 is a side view taken along 11---11 of **FIG. 9**; **FIG. 1** is a side view of a motor body according to the present invention;

FIG. 12 is a side view of the motor according to the invention;

FIG. 13 is a orthographic end view of **FIG. 12**;

FIG. 14 is yet another configuration of the motor according to the present invention;

FIG. 15 is a section view taken 15---15 in **FIG. 14**;

FIG. 16 is a section view taken 16---16 in **FIG. 14**;

FIG. 16a is an enlarged view of view of **FIG. 16**;

FIG. 17 is a side view of another configuration of the motor according to the present invention;

FIG. 18 is an orthographic projection of the side view described in **FIG. 17**;

FIG. 19 is a section view taken along 14---14 of **FIG. 17**;

FIG. 19a is a enlarged view described in **FIG. 19**;

FIG. 20 is another configuration of the motor according to the present invention;

FIG. 21 is an orthographic projection of the side view described in **FIG. 20**;

FIG. 22 is a side view of a yet another motor body configuration according to the present invention;

FIG. 23 is an orthographic projection of the view described in **FIG. 22**;

FIG. 24 is a section view taken along line 24---24 described in **FIG. 23**;

FIG. 24a is an enlarged view described in **FIG. 24**;

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Depicted in **FIGS. 1-3** is a motor **1** when expansion sleeve **13** is in means expanded as shown by dashed line **4** in the direction indicated by arrow **6** according to the invention. In **FIG. 1** motor **1** comprising is comprised of a main body **11** and an expansion sleeve **13**. The main body **11** has a left face **12** and right face **14**. The faces **12** and **14** are defined by a shape **16**. In **FIG. 2** main body **11** has an annular cavity **24** with a thick bottom **20**. In **FIG. 3** annular thick bottom **20** is bounded laterally by annular thick walls **26**. The upper portion of thick wall **26** has a flexure **30** ending with an opening wall **32** generally perpendicular to the thick bottom **20** thereby providing annular opening **28**. Flexure **30** has an interior surface **34** being parallel to thick bottom **20**. The corner of surface **34** and thick wall **26** is rounded **34** to eliminate stress concentration. Service channel **38** connecting cavity **24** with and open to outside is removably blocked with check screw **40**. Pressure channel **42** also open to the outside is threaded to accept plunger **44** and is bored **46** to provide surface for seal **48**. **FIG. 3a** shows the expansion sleeve **13** having been joined with a fusible alloy **52**. Plunger **44** is screwed in direction indicated by movement arrow **50** this compressing fluid in confined cavity **24** causing expansion sleeve **13** to bulge **54**. Stress concentration is further relieved by groove **56**. **FIG. 3b** demonstrates expansion sleeve **13** with flange **60** having rounded corner **62** joined with fusible alloy **52** to thick wall **26**. In **FIG. 3c** annular cavity **24** is cast **66** in motor **1**. **FIG. 4-5** where **FIG. 4** is end view of expansion sleeve **13** and **FIG. 5** is a side view with a break out while **FIG. 5a** is a view to demonstrate another configuration of sleeve **13** having flange **60** and rounded corner **62**.

In **FIG. 6-8** **FIG. 6** another configuration the motor **1** is in accordance to the present invention whereby expansion **70** is in direction shown by vector arrow **74**. Motor **1** has a main body **88** and an insert **90** with a stress relief groove **98** spaced from around the perimeter. In **FIG. 7** it is shown insert **90** is joined with a fusible alloy **89**. In **FIG. 8** the width of arch cavity **76** is bound radially by thick walls **78** and the length is by longitudinal thick walls **94**. Thereby arch cavity **76** has a bottom **80** and is surrounded by

walls 76 and 94 having a flexure protrusion 82 ending with opening wall 92 along the top edge and has an inside surface 84 that is with a rounded corner 86 to thick wall 76 and 94. FIG. 7a is an example of insert 90 having a flange 92 around the inside wall 98 perimeter and a fillet 72. FIG. 7b shows the motor 1 as a molded part 99. Insert 90 is shown in FIG. 9-11 with a plan view shown in FIG. 9 and an orthographic view in FIG. 10.

Yet another configuration of the motor 1 according to the invention is demonstrated in FIG. 12-15 is having motor 1 configuration arrayed plural radial around the body 102. The force vectors 74 radiate approximately perpendicular to the center axis 100.

Another configuration of the motor 1 according to the invention is demonstrated in FIG. 14-16 is having a motor body 110 and thick arch sections 112. In FIG. 16 it is seen that main body has annular groove 114 with rounded corner 118 to relieve stress concentration with a remaining thin wall 122. Groove 114 partially filled with arch sections 112 and all joints sealed with fusible alloy 52 resulting in cavity 116. To further relieve stress annular inside groove 120 is grooved in inside wall 124. When cavity 116 is pressurized thin wall is expanded 118 in direction of vector arrow.

In FIG. 17-19 another configuration of the motor 1 is shown in FIG. 17 in whereby expansion is area 150 in direction shown by vector arrow 152. Motor 1 has a main body 156 and a cavity 158 extending to a thin wall 152 with a stress relief groove 160 spaced from around the perimeter of local area 152. In FIG. 18 it is shown that cavity 158 to a depth to provide for a thin wall 152 with fillet corners 166 further eliminate stresses. A congruent plug ~~168~~ which provides space for cavity 170 is joined with a fusible alloy 89.

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Yet another configuration of the motor 1 according to the invention is demonstrated in FIG. 20-21 is having motor 1 configuration arrayed plural radial around the body. The force vectors 152 converge approximately perpendicular to the center axis 100.

Another configuration of motor 1 shown in **FIG. 22-24** according to the invention is taught in **FIG. 22** whereby expansion 170 is achieved in direction of vector arrow 180. **FIG. 23** shows the body 168 with congruent plug 172 fused 174 to body 168. In **FIG. 24** opening 178 extends to thin wall with congruent plug 172 providing for cavity. When cavity has pressure, thin wall 176 has bulge 170 in direction of vector arrow 170. **FIG. 24a** shows the thin wall 176 bulge 170 with stress being taken with round corner 178 and groove 182 spaced around thin wall 176.

The present invention may, of course, be carried out in other specific ways other than those herein set forth without departing from the spirit and essential characteristics of the invention. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.